Aerospace & Defence

The UK’s attempt to make hypersonic flight a reality

Reaction Engines is part of a consortium developing an engine for military aircraft that could fly five times the speed of sound

The fictional hypersonic Darkstar jet from the film 'Top Gun: Maverick' © Paramount Pictures/Mariusz Burcz/Alamy

Sylvia Pfeifer in Oxfordshire YESTERDAY

Two workers at aerospace start-up Reaction Engines are meticulously threading hundreds of ultra-thin metal tubes beneath a set of small bars.

Once each module is complete, sheets of these tubes are arranged in overlapping spirals to form a system that can cool air from 1,000C to below zero faster than the blink of an eye.

The Oxfordshire-based group is part of a UK-led military project aiming to make hypersonic flight a reality with the development of an unmanned air vehicle capable of flying at Mach 5 — five times the speed of sound, or 3,800mph.

The consortium, which includes aero-engine group Rolls-Royce, the Royal Air Force and the defence research agency DSTL, hopes to fly a demonstrator vehicle as early as the middle of this decade.

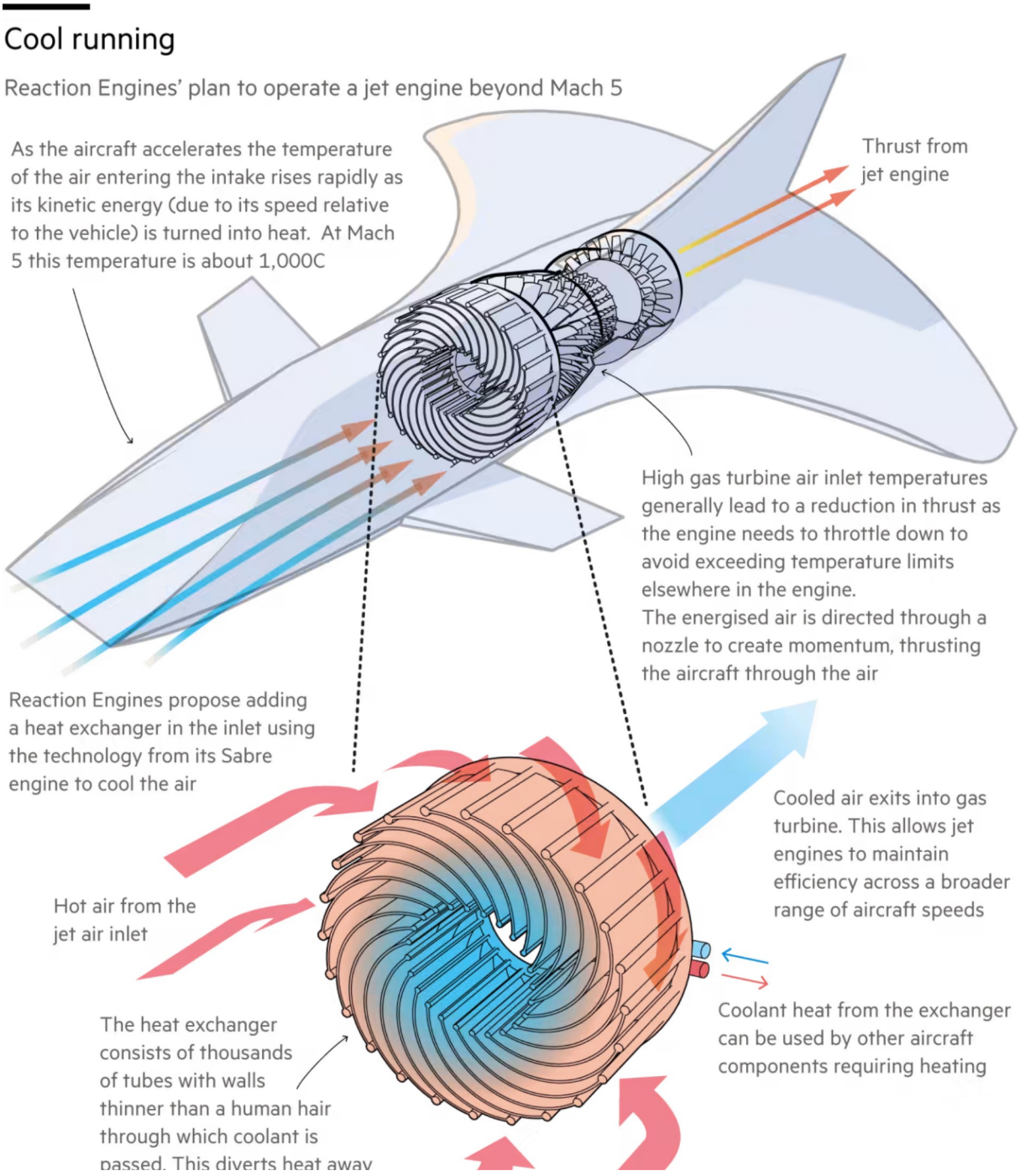
"The UK needs to accelerate out of the blocks on this," said Mark Thomas, chief executive of Reaction Engines. The emphasis of the UK project was to build a "low-cost" and "reusable" hypersonic vehicle that came back ready to fly another mission, he added.

The search for ever-higher speeds has fascinated engineers, scientists and the general

public for decades. In 1967 the US's X-15 hit a speed of 4,520mph — 6.7 times the speed of sound — when Major William Knight piloted the rocket-powered experimental aircraft.

One of the stars alongside Tom Cruise in this year's box office hit *Top Gun: Maverick* is the hypersonic fighter jet SR-72 Darkstar. Although fictional, the plane evokes Lockheed Martin's SR-71, which in the 1960s set a speed record for a piloted jet aircraft of Mach 3.2, or 2,455mph.

The US, Russia and China are developing missiles that can fly at hypersonic speeds, making them harder to track and intercept than conventional ballistic missiles.



from the inlet air

Graphic: Ian Bott; Bob Haslett
Source: Reaction Engines
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Separately, a clutch of start-ups are working on designs for supersonic (above 767mph, or Mach 1 — the speed of sound) as well as hypersonic flight.

In the case of the British effort, the aim is to develop a hypersonic engine that could potentially form the basis for a reconnaissance or combat aircraft. A potential model of the single-engine hypersonic concept vehicle, Concept V, which might be as large as a Hawk trainer jet, was unveiled by the partners at the Farnborough air show in July.

Key to the system will be Reaction Engines' innovative pre-cooler heat-exchanger, originally developed by the company for a space plane. At hypersonic speeds, the temperature generated inside a conventional gas turbine would start to melt components unless they were cooled in some way.

The collaboration "picks up on [our] thermal management capability", said Robert Bond, head of future projects at Reaction Engines.

The company's heat exchanger can reduce the temperature of compressed air rushing into an engine from 1,000C to room temperature in a 20th of a second. This technology will be integrated into a Rolls-Royce gas turbine engine.

While it was still too early to discuss what the exact applications might be for the UK venture, said Bond, the question was whether it could enhance the UK's defence capability.

The company is also testing its pre-cooling technology on the other side of the Atlantic through a programme supported by the US Air Force Research Laboratory.

"There is a lot of focus on the finished system in the industry and among the public," said Phil Smith of US-based consultants BryceTech. While a commercial product akin to a passenger aircraft today was "decades away from now . . . there are incremental steps that need to be followed to get there".

Reaction Engines, he added, had the right funding and skills, and had "managed to conduct important tests of their technology".

For the Oxfordshire company, the alliance with the Ministry of Defence was "strategically important" but its focus was firmly on "commercialisation and other

"strategically important" but its focus was firmly on "commercialisation and other routes to market", said Thomas.

It hopes its pre-cooling technology will draw interest from other sectors, such as power generation and automotive, under the umbrella of its applied technologies division.

The division's order book has risen to more than £10mn this year, with a target to double it in 2023. The company is in the process of concluding a funding round focused on the commercial applications of its technology.

It recently signed an agreement with US industrial group Honeywell to collaborate on the development of thermal management technologies to help reduce aircraft emissions. Its cooling technology has also helped Formula One team Mercedes.

Thomas also sees a role for Reaction Engines' technology in the recovery of waste heat, "taking waste from a factory or an industrial process, running it through the heat exchanger and extracting more energy".

The company has the backing of a mix of long-term strategic and financial investors, including BAE Systems, Rolls-Royce and Boeing, as well as asset management firm Baillie Gifford.

Luke Ward, investment manager at Baillie Gifford, said the "performance and efficiency of almost all engineering systems is limited by successful heat management".

"By pioneering and proving their technology in one of the most demanding applications out there — hypersonic flight — Reaction Engines has produced an extremely lightweight and high-performance group of heat exchange technologies."

Thomas is also happy to remain based in the UK, despite the allure of the US market. He insisted: "We are doing very well here so there is no incentive or need for us to jump over to the US. We are very well regarded as a British company that can play in the US market."